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A STUDY OF BONDING BETWEEN GLASS AND PLASTIC IN GLASS-REINFORCED PLASTICS: PHASE I

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I INTRODUCTION

Current practice in the manufacture of glass-reinforced plastic materials involves application of a "finish" on the cleaned glass fiber prior to application of the resin. The most common finishes are alkenyl- or alkyl-silane types of finishes which, presumably, are bonded to the glass surface via silicon-oxygen-silicon chemical linkages. The alkenyl or alkyl groups of the silane "finish" provide "handles" for bonding to the subsequently applied polymer phase.

Glass-reinforced plastic materials prepared in this way are subject to a number of shortcomings. For example, their mechanical properties change greatly with age, and especially with exposure to water. Further, the initial mechanical properties vary greatly from one lot of product to another. Much evidence gained from the field and from product development studies points to "bonding" between the glass phase and the polymer phase as the seat of many of these shortcomings.

This project is a study of other types of "bonding" between organic phase and glass phase which is not dependent upon the hydrolysis-labile Si-O-Si linkage which is supposedly present with silane-type "finishes."

II OBJECTIVES

The ultimate objective of this work is to investigate methods for "bonding" a polymer to a glass substrate via a silicon-carbon chemical linkage.

The objective of this Phase I is to investigate methods for halogenation of a glass surface, with formation of silicon-chlorine or silicon-fluorine bonds.

The objective of a future Phase II is to investigate utilization of surface-based silicon-halogen bonds for formation of silicon-carbon bonds.

III SUMMARY

This first quarter of the work period was required to obtain starting materials and to construct apparatus.

Starting Materials

On hand, as of August 30, are: Ottawa sand, a fine grade of about 99% SiO_2; Cab-O-Sil, a submicroscopic quartz powder of 99.0% - 99.1% SiO_2; Eccospheres S-1, composed of thin-walled quartz bubbles of >95% SiO_2; and three polished quartz crystals, 1/4-in. x 3/4-in. x 3/4-in., each crystal cut along one of the three coordinate axes of the SiO_2 crystal.

Other starting materials will be obtained as needed.

Apparatus

A fluidized-bed reactor has been prepared from Vycor tubing and spherical-joint fittings. It is equipped with a tubular electrical heating furnace, a chromel-alumel thermocouple, and a flow meter for measuring the flow-rate of reactant gases.

Experimental

A trial run has been made, based on the reaction between carbon, chlorine, and Ottawa sand.

$$2Cl_2 + SiO_2 + 2C \longrightarrow SiCl_4 + 2CO$$

IV FUTURE WORK

Work during the next quarter will emphasize the reaction between quartz and chlorinating agents.

Respectfully submitted,

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DLC:sks